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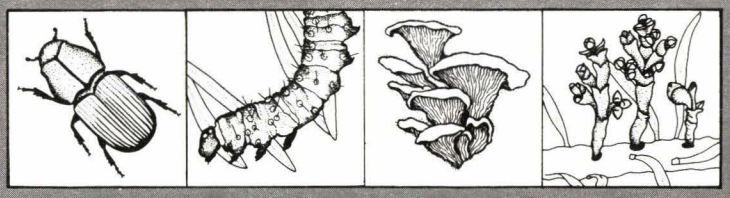

Report No. 80-14

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DWARF MISTLETOE LOSS ASSESSMENT ON THE BITTERROOT AND LOLO NATIONAL FORESTS, MONTANA

BY

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ABSTRACT

We conducted a combination road/plot survey for dwarf mistletoe in Douglas-fir (DF), lodgepole pine (LP), and western larch (WL) on the Bitterroot and Lolo NF's in 1979. Infestation percentages were:

Species	Bitterroot	Lolo
DF	43	17
LP	44	23
WL	52	30

Annual cubic foot volume losses were:

Species	Bitterroot	Lolo
DF	3,258 M	2,122 M
LP	467 M	701 M
WL	32 M	240 M
Total	3,757 M	3,063 M

1/ Plant Pathologist, Biological Technician, and Statistical Assistant, respectively.

INTRODUCTION

We surveyed the Bitterroot and Lolo National Forests (figure 1) in 1979 to help us estimate incidence of dwarf mistletoe in Douglas-fir, lodgepole pine, and western larch. We also estimated cubic foot volume loss in lodgepole pine. Our survey should provide the land managers better information for use in decisionmaking.

OBJECTIVES

Our objectives were to:

1. Determine distribution and intensity of dwarf mistletoe in Douglas-fir, lodgepole pine, and western larch on the Bitterroot and Lolo National Forests in western Montana.

2. Determine cubic foot volume loss due to dwarf mistletoe on lodgepole pine.

3. Estimate cubic foot volume loss due to dwarf mistletoe on Douglas-fir and western larch.

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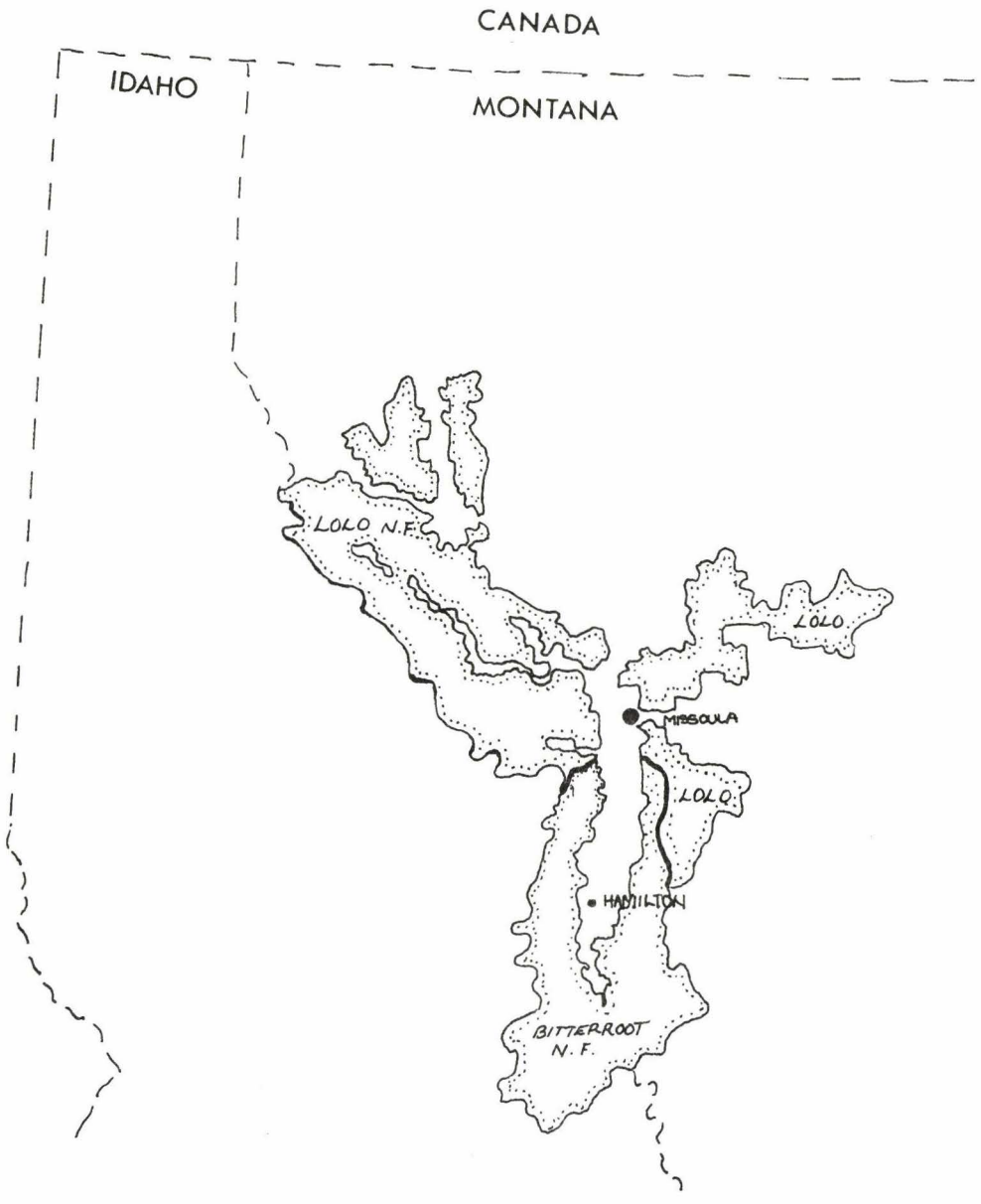

Figure 1.--Montana National Forests surveyed for dwarf mistletoe impact in 1979.

METHODS

Our survey was based on a combination road/plot system developed by Drummond (1978). Three two-person crews drove all passable roads on the two Forests at speeds less than 10 miles per hour. The crews observed a 1-chain wide strip on the right side of the road and recorded mileage to the nearest 0.1 mile whenever there was a change in type, size class, or dwarf mistletoe infection intensity. These terms are defined as:

Type -

Douglas-fir = >1/3 of stand is Douglas-fir.

Lodgepole pine = >1/3 of stand is lodgepole pine.

Western larch = >1/3 of stand is western larch.

Size Class -

Seedling/Sapling = trees <4.9 inches d.b.h.

Pole = trees 5.0 to 8.9 inches d.b.h.

Mature = trees >9.0 inches d.b.h.

Infection intensity -

0 = no infection.
1 = <1/3 of the trees infected.
2 = 1/3 to 2/3 of the trees infected.
3 = >2/3 of the trees infected.

The crews also established variable radius plots (BAF 10) at 3-mile intervals, normally placed 2 chains into the stand on the right side of the road. If that direction was nontype, the plot was placed on the left side of the road. If both sides were nontype, that fact was recorded and the plot discarded without replacement. The crews recorded d.b.h., height, and dwarf mistletoe rating (DMR) on the six-class system (Hawksworth 1977) for all Douglas-fir, lodgepole pine, and western larch >4 inches d.b.h. One representative lodgepole pine on each plot was aged from an increment core for site index calculations. Number of rings in the last inch of growth was recorded for Douglas-fir and western larch for growth rate calculations.

We used the road data to estimate the proportion of each type infested by determining the ratio of miles with infected trees present to the total miles of type.

We used the lodgepole pine plot data to relate cubic foot volume loss to dwarf mistletoe incidence. We first summarized the plot data using a Tektronix® desk-top microprocessor at Forest Insect and Disease Management/Methods Application Group (MAG), Davis, CA; then ran the data through simulated yield program RMYLD (Edminster 1978) on the Univac® 1100 at Ft. Collins, CO (FCCC).

Plot data for Douglas-fir and western larch were summarized either by hand or with the FCCC Univac® 1100. We currently have no simulated yield models for either Douglas-fir or western larch.

RESULTS AND DISCUSSION

Road survey.--Road data are summarized in tables 1 and 2. Dwarf mistletoe infestation percentage was calculated for each type from tables 1 and 2:

$$\text{Infestation percentage} = \frac{\text{Miles severity categories 1+2+3}}{\text{type miles}} \times 100$$

Infestation percentages are:

Bitterroot NF

Douglas-fir	43.2
Lodgepole pine	44.3
Western larch	51.8

Lolo NF

Douglas-fir	17.4
Lodgepole pine	22.6
Western larch	30.0

Table 1.--Miles of road surveyed on the Bitterroot National Forest by species, size class, and dwarf mistletoe infection intensity

Dwarf mistletoe infection 1/	Douglas-fir				Lodgepole pine				Western larch			
	Size class 2/				Size class				Size class			
intensity	SS	P	M	Total	SS	P	M	Total	SS	P	M	Total
0	6.1	53.8	93.6	153.5	45.2	36.2	8.6	90.0	0.6	0.5	0.2	1.3
1	3.3	36.1	21.4	60.8	4.0	27.2	15.1	46.3	--	--	.8	.8
2	2.2	23.6	19.6	45.4	.2	8.3	9.3	17.8	--	.1	.5	.6
3	.1	5.7	5.0	10.8	--	2.8	4.8	7.6	--	--	--	--
TOTALS	11.7	119.2	139.6	270.5	49.4	74.5	37.8	161.7	0.6	0.6	1.5	2.7

1/ Infection intensity:

0 - no infection
1 - <1/3 of trees infected
2 - 1/3 to 2/3 of trees infected
3 - >2/3 of trees infected

2/ Size class:

SS - seedling-sapling, <4.9 in. d.b.h.
P - pole, 5.0 to 8.9 in. d.b.h.
M - mature, >9.0 in. d.b.h.

Table 2.--Miles of roads surveyed on the Lolo National Forest by species, size class, and dwarf mistletoe infection intensity

Dwarf mistletoe infection	Douglas-fir				Lodgepole pine				Western larch			
	Size class				Size class				Size class			
intensity	SS	P	M	Total	SS	P	M	Total	SS	P	M	Total
0	42.7	273.5	227.9	544.1	54.7	228.7	135.9	419.3	26.5	28.7	40.2	95.4
1	3.9	35.6	25.4	64.9	11.9	57.7	21.8	91.4	.3	8.2	11.2	19.7
2	2.2	15.7	10.2	28.1	1.7	14.0	8.6	24.3	--	5.4	8.7	14.1
3	.8	10.5	10.1	21.4	--	1.7	5.3	7.0	--	1.6	5.5	7.1
TOTALS	49.6	335.3	273.6	658.5	68.3	302.1	171.6	542.0	26.8	43.9	65.6	136.3

Plot survey, Douglas-fir.--We currently have no simulated yield programs for dwarf mistletoe-infested Douglas-fir. Haglund and Dooling (1972) compared a healthy stand to a severely infested stand on the Flathead Indian Reservation, and determined losses to be about 74 cubic feet per acre per year. Losses vary from none for light intensity infestations to the 74 cubic feet per acre per year found by Haglund and Dooling (1972). An average for all infestation intensities would be about 20 cubic feet per acre per year.

Douglas-fir type occurs on 377 M acres on the Bitterroot NF. Two hundred twelve plots were in type; 47 plots were dwarf mistletoe-infested (22.2 percent). The road survey data is used for determining the proportion of type infested, and that data showed 43.2 percent infested. About 162.9 M acres of type are infested for an annual cubic foot volume loss of 3,258 M.

Douglas-fir type occurs on 610 M acres on the Lolo NF. Five hundred twenty-eight plots were in type; only 38 plots were dwarf mistletoe-infested (7.2 percent). The road data showed 17.4 percent infested. About 106.1 M acres of type are infested for an annual cubic foot volume loss estimate of 2,122 M.

Plot survey, lodgepole pine.--Figure 2 is an example of the original field data summarized on the MAG Tektronix®. These figures were used to drive RMYLD to produce a simulated yield table for each plot. RMYLD calculates the impact of dwarf mistletoe in arriving at volume predictions. A subroutine on a second run suppresses all infection data, and tables are produced as though infection were not present. The difference between the two tables is then taken as the 10-year impact of dwarf mistletoe.

Yield tables for one of the Bitterroot plots are shown in figures 3, infested, and 4, noninfested, as illustration. Loss data was summarized from the pairs of yield tables for each plot as cubic foot per acre per year volume loss by DMR class. Loss on the Bitterroot NF is 7.9 cubic foot per acre per year (table 3). Loss on the Lolo NF is 6.9 cubic foot per acre per year (table 4).

Lodgepole pine type occurs on 133.4 M acres on the Bitterroot NF. Eighty-nine plots were in type; 39 plots were dwarf mistletoe-infested (43.8 percent). The road data showed 44.3 percent infested. About 59.1 M acres of type are infested for an annual cubic foot volume loss estimate of 466.9 M.

DATA FOR THE LOLO TO BE RUN ON RMYLD

PLOT	SITE	AGE	CAL. DBH	HT	DEN	DMR	AGE +20	AGE +10	#TR/ POINT	ACT. DBH	% LP
6	102	55	13.9	70.0	9	0.0	75	65	1	13.9	
8	118	51	12.4	76.0	24	0.0	71	61	2	12.4	
17	43	130	6.9	50.0	39	0.0	150	140	1	6.9	
22	68	60	6.4	50.0	134	0.0	80	70	3	6.4	
23	50	145	13.9	60.0	9	0.0	165	155	1	13.9	
28	95	35	5.8	46.5	545	0.0	55	45	10	5.8	
58	46	98	4.6	45.0	520	0.0	118	108	6	4.6	
62	73	173	14.2	90.0	18	0.0	193	183	2	14.2	
63	113	57	9.6	80.0	139	0.0	77	67	7	9.6	
64	114	66	8.8	90.0	47	0.0	86	76	2	8.8	
69	59	54	4.4	40.0	474	0.0	74	64	5	4.4	
70	76	53	6.1	51.2	591	0.0	73	63	12	6.1	
72	71	44	12.4	41.7	36	0.0	64	54	3	12.4	
73	81	48	12.9	50.0	11	0.0	68	58	1	12.9	
74	79	36	8.6	40.0	25	0.0	56	46	1	8.6	
78	85	42	9.5	47.5	41	0.0	62	52	2	9.5	
80	64	68	6.2	51.2	191	0.0	88	78	4	6.2	
83	86	42	8.4	47.9	208	0.0	62	52	8	8.4	
84	75	31	7.5	50.0	65	4.0	51	41	2	7.5	
85	37	17	9.8	55.0	76	0.0	37	27	4	9.8	
86	103	104	11.2	105.0	15	0.0	124	114	1	11.2	
88	78	73	6.6	65.4	505	0.0	93	83	12	6.6	
91	57	82	5.6	51.2	468	0.0	102	92	8	5.6	
92	81	65	6.4	63.3	806	0.0	85	75	18	6.4	
94	75	173	11.0	75.0	.15	3.0	193	183	1	11.0	

Figure 2.--An example of original plot data summarized on the MAG Tektronix®

YIELDS PER ACRE OF LODGEPOLE PINE
PLOT NUMBER 094
02/13/80

SITE INDEX, 67 FT. 0-YEAR THINNING INTERVAL
THINNING INTENSITY-- INITIAL- .0 SUBSEQUENT- .0

		CHARACTERISTICS BEFORE AND AFTER THINNING								PERIODIC INTERMEDIATE CUTS						
STAND AGE YEARS	DMR	TREES NO.	BASAL AREA SQ.FT.	AVERAGE D.B.H. IN.	AVERAGE HEIGHT FT.	TOTAL VOLUME CU.FT.	MAI	MERCH. VOLUME CU.FT.	MAI	SAWTIMBER VOLUME BD.FT.	TREES NO.	BASAL AREA SQ.FT.	AVERAGE D.B.H. IN.	TOTAL VOLUME CU.FT.	MERCH. VOLUME CU.FT.	SAWTIMBER VOLUME BD.FT.	MERCH. CU.FT. SUBSAWLOG
150	4.3	223	96	8.9	56	2690	18	2460	16	10100							
160	5.0	201	103	9.7	57	2950	18	2730	17	11500							
						260[1/]					TOTAL YIELDS			2950	2730	11500	0

MERCH. CU. FT. - TREES 6.0 INCHES D.B.H. AND LARGER TO 4.0-INCH TOP.
BD. FT. - TREES 6.5 INCHES D.B.H. AND LARGER TO 6.0-INCH TOP.
MINIMUM REMOVALS FOR INCLUSION IN TOTAL YIELDS--
0. CUBIC FEET AND 0. BOARD FEET PER ACRE.
SAWTIMBER TOTAL YIELD INCLUDES REMOVALS LESS THAN 0. BF/ACRE IF
MORE THAN 0. MERCH. CF/ACRE WAS REMOVED.
INITIAL THINNING FROM ABOVE ALLOWED IN STANDS WITH DWARF MISTLETOE.
D.M.R. ABOVE WHICH PERIODIC THINNINGS WILL NOT BE EXECUTED - 3.0.
NO NONCOMMERCIAL THINNINGS ALLOWED.
CULMINATION OF M.A.I. MERCH. CU. FT.--AGE= 160 MAI= 17.
CULMINATION OF M.A.I. TOTAL CU. FT.--AGE= 150 MAI= 18.

1/ 10-year growth on plot

Figure 3.--Simulated yield table, dwarf mistletoe-infested plot from the Bitterroot National Forest.

YIELDS PER ACRE OF LODGEPOLE PINE
PLOT NUMBER 94
02/13/80

SITE INDEX, 67 FT. 0-YEAR THINNING INTERVAL
THINNING INTENSITY-- INITIAL- .0 SUBSEQUENT- .0

		CHARACTERISTICS BEFORE AND AFTER THINNING								PERIODIC INTERMEDIATE CUTS						
STAND AGE YEARS	DMR	TREES NO.	BASAL AREA SQ.FT.	AVERAGE D.B.H. IN.	AVERAGE HEIGHT FT.	TOTAL VOLUME CU.FT.	MAI	MERCH. VOLUME CU.FT.	MAI	SAWTIMBER VOLUME BD.FT.	TREES NO.	BASAL AREA SQ.FT.	AVERAGE D.B.H. IN.	TOTAL VOLUME CU.FT.	MERCH. VOLUME CU.FT.	SAWTIMBER VOLUME BD.FT.	MERCH. CU.FT. SUBSAWLOG
150	.0	223	96	8.9	56	2690	18	2460	16	10100							
160	.0	221	116	9.8	57	3330	21	3090	19	13000							
						640[1/]					TOTAL YIELDS			3330	3090	13000	0

MERCH. CU. FT. - TREES 6.0 INCHES D.B.H. AND LARGER TO 4.0-INCH TOP.
BD. FT. - TREES 6.5 INCHES D.B.H. AND LARGER TO 6.0-INCH TOP.
MINIMUM REMOVALS FOR INCLUSION IN TOTAL YIELDS--
0. CUBIC FEET AND 0. BOARD FEET PER ACRE.
SAWTIMBER TOTAL YIELD INCLUDES REMOVALS LESS THAN 0. BF/ACRE IF
MORE THAN 0. MERCH. CF/ACRE WAS REMOVED.
INITIAL THINNING FROM ABOVE ALLOWED IN STANDS WITH DWARF MISTLETOE.
D.M.R. ABOVE WHICH PERIODIC THINNINGS WILL NOT BE EXECUTED = 3.0.
NO NONCOMMERCIAL THINNINGS ALLOWED.
CULMINATION OF M.A.I. MERCH. CU. FT.--AGE= 160 MAI= 19.
CULMINATION OF M.A.I. TOTAL CU. FT.--AGE= 160 MAI= 21.

1/ 10-year growth on plot.

Figure 4.--Simulated yield table, dwarf mistletoe-free plot from the Bitterroot National Forest

Table 3.--Calculated growth impact from lodgepole pine dwarf mistletoe on the Bitterroot National Forest

Plot	DMR 1/	Infested 2/ 10-year growth, ft^3	Healthy 2/ 10-year growth, ft^3	10-year difference ft^3	Annual difference ft^3
12	2.5	130	130	0	0
14	1.7	320	330	10	1
18	5.0	70	230	160	16
48	5.0	50	80	30	3
72	1.5	150	150	0	0
73	2.0	100	100	0	0
74	1.5	310	310	0	0
81	1.0	400	400	0	0
94	4.3	260	640	380	38
95	4.0	190	320	130	13
96	1.0	170	170	0	0
102	1.7	140	140	0	0
107	.3	640	640	0	0
108	1.5	250	250	0	0
115	2.7	510	510	0	0
117	.6	690	690	0	0
118	2.1	600	620	20	2
119	5.0	180	360	180	18
136	.5	370	370	0	0
142	3.9	290	720	430	43
146	3.7	340	340	0	0
151	5.0	110	190	80	8
157	4.2	210	410	200	20
150	3.2	440	440	0	0
154	2.3	290	320	30	3
155	.4	1,600	1,600	0	0
161	1.0	210	210	0	0
163	3.8	350	480	130	13
164	3.4	410	540	130	13
166	5.0	50	120	70	7
169	4.8	100	440	340	34
1015	3.2	210	280	70	7
1083	4.0	70	140	70	7
1084	2.0	460	490	30	3
2323	1.5	160	160	0	0
2367	1.6	550	550	0	0
2372	4.3	-150	370	520	52
2382	.4	540	540	0	0
2396	4.0	270	340	70	7
39				3,080	308

7.9 ft^3/ac/yr

1/ 6-class rating system 2/ From yield tables (see figures 3 and 4)

Table 4.--Calculated growth impact from lodgepole pine dwarf mistletoe on the Lolo National Forest

Plot	DMR 1/	Infested 2/ 10-year growth, ft^3	Healthy 2/ 10-year growth, ft^3	10-year difference ft^3	Annual difference ft^3
84	4.0	300	360	60	6
94	3.0	130	160	30	3
97	.2	760	760	0	0
201	.5	700	700	0	0
202	6.0	-20	260	280	28
215	.3	240	240	0	0
251	2.8	680	750	70	7
282	5.0	50	110	60	6
287	4.0	130	130	0	0
288	2.0	140	140	0	0
295	2.0	550	560	10	1
307	3.0	230	230	0	0
311	2.4	1,140	1,360	220	22
312	1.5	370	370	0	0
322	1.2	710	710	0	0
325	4.2	370	930	560	56
328	1.0	230	230	0	0
329	6.0	-60	200	260	26
43	3.0	160	160	0	0
353	4.7	150	390	240	24
1003	4.2	560	900	340	34
1007	2.8	710	970	260	26
1012	2.0	140	140	0	0
1016	.3	710	710	0	0
1116	2.5	210	320	20	2
1385	.6	350	350	0	0
1145	1.0	130	130	0	0
1172	2.0	200	200	0	0
1179	3.2	320	350	30	3
1184	.4	430	430	0	0
2042	2.5	210	230	20	2
2074	2.0	150	150	0	0
2216	.1	1,340	1,340	0	0
2237	.1	1,440	1,440	0	0
2272	2.3	850	900	50	5
2306	.3	410	410	0	0
1307	3.0	170	220	50	5
1335	2.2	480	490	10	1
1338	2.0	210	210	0	0
1344	1.4	820	820	0	0
1345	6.0	-30	120	150	15
1348	3.7	230	410	180	18
1367	3.4	360	440	80	8
43				2,980	298

6.9 ft^3/ac/yr

1/ 6-class rating system 2/ From yield tables (see figures 3 and 4)